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Sacks for storing solid waste were initially tried in Europe but recently--within about the last 12 years--their use has spread to the United States. Much research has been done on solid waste sacks, both paper and plastic. Many communities have tried paper sacks, plastic sacks, or both in test areas to determine their acceptability as solid waste storage containers and to identify their effect on solid waste collection and disposal. The purpose of this paper is to summarize what research has been done and the reported findings of the many test and community-wide programs on this subject.

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SPRINGFIELD, VA. 22161

# PAPER AND PLASTIC SOLID WASTE SACKS

*A Summary of Available Information*

A Division of Technical Operations
Open-File Report (TO 18.1.037/1)

written by
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U.S. ENVIRONMENTAL PROTECTION AGENCY
Office of Solid Waste Management Programs
1971

# PAPER AND PLASTIC SOLID WASTE SACKS
## A SUMMARY OF AVAILABLE INFORMATION

Betty L. Grupenhoff and Kenneth A. Shuster

Sacks for storing solid waste were initially tried in Europe but recently--within about the last 12 years--their use has spread to the United States. Much research has been done on solid waste sacks, both paper and plastic. Many communities have tried paper sacks, plastic sacks, or both in test areas to determine their acceptability as solid waste storage containers and to identify their effect on solid waste collection and disposal. The purpose of this paper is to summarize for interested persons, whether community leaders, manufacturers, solid waste collection agencies, or private citizens, what research has been done and to summarize the reported findings of the many test and community-wide programs. Hopefully this paper will aid in eliminating a duplication of effort in future investigations of the subject and in indicating areas needing additional study.*

Although there is published information on experiments done on solid waste sacks in England, Germany, Sweden, and other European countries, the information presented here will refer only to studies conducted in the United States. It is believed that the U.S. studies will be of greater interest and will be more relevant to further work on solid waste sacks in this country. All the sacks referred to in this paper are those constructed for the specific purpose of storing solid waste.

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*Inclusion or exclusion of any manufacturer does not necessarily imply endorsement or nonendorsement by the U.S. Government.

At this time it seems appropriate to describe the basic sacks and accessories which are used for storing solid waste. There are three basic types of sacks--paper, plastic, and paper with plastic liners. The first of these types, paper sacks, is made of a special wet strength paper[1] and usually is used in conjunction with a hoop holder with lid. These holders may be attached either to a wall or pole or to a stand. Some of the stands used have sheet metal sides to protect the sacks inside them. In addition, some paper sacks are square-bottomed and designed to stand free of any holder. When they are filled with solid waste, the paper sacks are closed by folding over their tops.

The second type of sack for solid waste, plastic sacks, is usually made of a polyethylene or ethylene copolymer resin.[1] Holders fixed to walls or stands are also used for plastic sacks, but the sacks are more frequently used as plastic liners in conventional metal or plastic cans which most homeowners already have. When the sacks are filled, they are usually closed with wire ties although sacks with drawstrings have been marketed.[2]

Paper sacks with plastic liners are also available for solid waste. Sacks of this type are used in the kitchen compactors, which have recently come on the market.

At present we know of 47 companies which manufacture sacks. Lists of the companies which manufacture paper solid waste sacks and those which manufacture plastic sacks and liners are presented in Appendix I and Appendix II respectively. It should be noted that two companies make both types of sacks.

To our knowledge as of April 1, 1971, 44 communities in 20 states have tested and/or are now using paper sacks for solid waste storage, and 25 communities in 11 states have tested and/or are now using plastic sacks. Four communities have tested and/or are now using both paper and plastic sacks. A list of these communities is presented in Appendix III. Sacks are also being used by many companies, institutions, hospitals,[3,4] housing developments, homeowners associations, and individual citizens for the handling of solid waste, but very little information has been published on these uses.

A literature search, contact with some of the sack manufacturers, review of pertinent Federal solid waste management program demonstration grants, and discussions with other people gave some idea of the type of information which is available on the subject of paper and plastic sacks. Most of the available information consists of personal experiences communities have had with sack systems. This information falls into one or more of the following areas: (1) description of the system, (2) listing of advantages and disadvantages, and (3) opinions of those people involved in the system.

Description of the system is usually limited to identification of the manufacturer of the particular sack being used in the community.[2,5-23] Occasionally there is a short description of the collection system used by the community and of tests performed on the sacks.[2,5,9,15,18,21,23-28] Information on bag specifications is limited.[1,2,21,23-25,27,29,30] The National Sanitation Foundation, however, has recently published two sack standards, one for paper and one for plastic sacks.[1] Tests made to determine the appropriate gauge for polyethylene bags for various cities

such as Lebanon, Ohio; Florissant and St. Louis, Missouri; and Inglewood, California are mentioned but they are not treated in great detail.[2,24] Information is also sometimes given on method of sack distribution, user cost and method of paying for the sacks.[2,5,6-9,18,23,26-28,31] Distribution methods include door to door delivery by the collection agency (e.g., delivered as a newspaper),[27] homeowner pickup at municipal or commercial buildings (e.g., city hall, police and fire stations, supermarkets, banks, etc.), homeowner purchase at retail outlets,[11,28] or a combination of these. Not all of these methods have been found satisfactory. One community reported fire-fighting capabilities could be hindered by too many persons picking up sacks at fire stations.[11] Sometimes retailers will sell sacks for the collection agency at bag cost or for the cost of the bags plus a collection fee. In this last instance the sacks are specially marked.[28]

The retailer then turns the money over to the collection agency often receiving no monetary margin for this service but being satisfied by the increased customer traffic. Sometimes the community or collection agency supplies the sacks and holders through taxes or direct fees, and sometimes the user purchases them outright from a retailer. Sometimes the collection savings from sack use are passed on to the homeowner who pays a minimal fee or no fee at all for the sacks. In some communities, the use of sacks is voluntary,[8,9,11,23,25] and in others their use is mandated by city ordinance.[5-7,10,14,18,27,28]

A listing of advantages is the most frequently occurring type of information available. These advantages can usually be divided into three general categories: (1) economic benefits in terms of both time

and cost savings, (2) aesthetic benefits, (3) health benefits. Each of these types of benefits in turn can be viewed in respect to the basic operations involved in handling solid waste: storage, collection and disposal.

With respect to the storage of solid waste the economic benefits which have been cited are based on the idea that sack holders generally have a longer life than galvanized cans and therefore do not have to be replaced as often as cans. Since holders are not handled as much as galvanized cans they remain neat and attractive many years longer than galvanized cans.[8,9,17] Based on similar reasoning a savings will be realized if sacks are used as liners because the cans are handled less and will not have to be replaced as often.

Economic benefits in the area of collection are the most frequently mentioned benefits. These savings are basically the result of increasing operating efficiency.[2,4,5,11,12,14-16,18,20-22,25,26,29-34,39] Reasons most often cited for this increased efficiency are: (1) fewer items to handle;[6,7,17,18,25] (2) items easier to handle (e.g., less container weight, easier to grasp, can be tossed, etc.)[2,6-12,15-17,21,23-26,31,33,34] (3) no set-back motion required to replace container;[2,6,7,11,12,15,17,22,31,33,34] (4) no time spent trying to dislodge contents of cans.[12] This increased efficiency was frequently reported as the cause of a reduction in manpower needs,[2,5,7,10,11,14,15,19,23,24,32,34-36] which in turn accounted for a reduction in labor costs, and as the cause of an increase in the number of services that could be handled. Another advantage of sacks is they are easier for the homeowner to take to the curb and thereby they reduce citizen resistance to the transition from

backyard to curbside collection. This change in collection procedures results in substantial savings in collection costs. In addition a savings in both capital and maintenance costs was reported as a result of the use of open dump trucks for collection of sacks.[5,22,29,32,37] The use of an open truck, however, was usually mentioned as an emergency measure, saving the community the expense of another packer truck. The one exception was College Park, Maryland, which uses specially designed open trucks as standard equipment.[5,37]

Very little information was found on economic benefits obtained from the use of sacks in the area of disposal. Three references cited reduced number of trips to disposal sites as a result of the greater volume and weight of garbage and trash compacted in packer bodies.[8,9,16] This point, however, needs further explanation. Some references mentioned the effects of the paper and plastic sacks on incineration or landfill operations, but they gave no description of the tests performed to arrive at their conclusions.[2,11,20,23,25,26,28,29,31,33,38]

Aesthetic benefits reported fall into the two categories of storage and collection operations. In the storage of solid waste two types of benefits cited are a neater appearance of the community and less odor.[2,4,7,10,16-20,22-26,29-31,33,34] In the collection operation, less spillage of solid waste at the truck,[2,5,9,11,12,14,20,25,26,29,31,33,34,39] substantial minimization of blowing trash[33] and a quieter collection[2,4,5,9,11,12,14,15,23,25,26,29,33,34,36,39] are mentioned by some communities. College Park, Maryland, which uses open dump trucks instead of compactors reported quieter collection due to the absence of compactor noise as well as the use of sacks.[5]

Reduction of the fly population and of potential hazards from rats,[2,9,15,16,25,26,29,31,40,41] as well as a more sanitary overall system,[2,5,7-11,15-17,20,22-31,33,34,36,39] are given as the main health benefits achieved by using paper or plastic sacks for storing solid waste. In the area of collection these health benefits take the form of fewer back injuries for the collector since he no longer lifts heavy cans, a reduced number of cuts resulted from the jagged edges on metal cans, and fewer injuries at the back of the collection truck with the packer mechanism.[2,4,11,16,25,29,31,33,34,39] In addition, sacks eliminate for the collector any contact with the solid waste which protects him from any possible diseases carried by the waste and injuries from sharp objects in the can. Paper and plastic sacks also eliminate the need to wash receptacles,[2,10-12,17,34,42] thereby eliminating the tendency of people not to properly clean their galvanized cans. This tendency causes increased insect and rodent problems, bad odors and possible disease.

A frequently listed disadvantage to using sacks is their cost. Although this is a factor, some communities feel that by buying large quantities at bulk prices and by making the system a city-wide operation they will be able to realize enough savings from increased collection efficiency to cover the added expense.[5,17] Another frequently listed problem is the distribution of the sacks.[2,11,23,26,27] Some other difficulties were occasionally mentioned but often it was impossible to determine whether the problems existed because of the use of an inferior bag or because it is impossible to manufacture a bag which can solve all the problems. The disadvantages which were reported with respect

to plastic sacks include reports that the bags are easily punctured by glass or other sharp objects; are damaged by dogs and other animals; sometimes leak; and do not withstand heavy snow and icing.[2,12,20,23,25-27,30,32,34] College Park, Maryland, reported one problem which resulted from a dissatisfaction among the men in having to work alone and the difficulty in securing men who would be responsible and conscientious.[32] It should be noted that these things were not considered as problems by all the communities examined. For example, the one man crew in Inglewood showed increased sense of responsibility and personal pride in his route.[2] Some of the problems cited earlier were even reported as solved by the use of sacks. One example is the problem of stray dogs bothering waste cans and not sacks.[9,11,15,22]

One area concerning the use of sacks which has been studied by most communities is the opinion of the people who are personally involved in the system. Most communities have tried to evaluate the users' opinions of the system, and some report the opinions of the collectors. For the most part, questionnaires, sometimes pre-test and post-test questionnaires, have been used to determine the public's acceptance of the system. Occasionally personal interviews were used for this purpose.[43] The general attitude of the people was one of satisfaction with the sack system and in some cases even willingness to assume the extra cost of sacks themselves.[2,5-9,11-17,18-21,23,25,26,30,33,34,37,39,43] As a result of the pre-test and post-test questionnaires it was noted that familiarity with the system frequently improves the user's attitude toward it.[10,18,21] One report showed homeowner preference for tie-wire rather than drawstring closures for plastic sacks.[2] Collectors

questioned generally expressed the same attitude of satisfaction with the system.[19,21,33]

The most comprehensive investigation of plastic and paper sacks has been done by Ralph Stone and Company, Inc., Engineers, through a Federal solid waste management program demonstration grant in Inglewood, California. In their final report "Solid Waste Bags System Study,"[2] which was submitted for program review, they covered the following topics: (1) bag materials testing: tensile stress-strain analysis; impact puncture resistance; tearing characteristics after perforation and pinholes; effects of temperature exposure; strength when soaked in various oils and water; creep; and moisture content and absorption characteristics; (2) user reaction which was measured by five questionnaires, and a survey of continued bag usage on a voluntary basis after the bags for the demonstration were no longer distributed; (3) microbiological and dust scatter tests; (4) tests on bin liner (2 and 3 cu yd) use; (5) survey of the effects of bags on disposal operations (sanitary landfill and incineration-qualitative); (6) environmental comparisons (cans versus bags): noise, flies, litter, safety; (7) time studies: cans versus bags and paper versus plastic bags; (8) number of items and capacity utilized with respect to cans versus bags.

In reviewing the literature currently available on the subject of paper and plastic sacks there appear to be certain areas which need to be further investigated. These include: (1) an evaluation of various bag distribution and user charge systems in use, (2) the effect of bags with respect to time and cost on backyard collection, (3) the heat and fire resistance of plastic liners by themselves and as they relate to

the cans, (4) the development of standards, especially for holder-bag compatibility and standard bag dimensions, (5) bag closing capabilities of paper bags, (6) effects of sacks on truck capacity, and (7) effects on incineration and disposal. Numbers 2 and 4 above are two of the four recommendations of the Ralph Stone and Company, Inc., Engineers study. Although the study did develop a model based on average and estimated times, it would be worthwhile to develop a regression model for cans versus paper and plastic bags and the respective cost model similar to the satellite vehicle and backyard models already developed by the Federal solid waste management program. If this work is undertaken more time study data would be required since Ralph Stone and Company, Inc., Engineers only did time studies on the one-man crew size and curb collection.

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4. St. Regis Environmental Systems Division. Environmental Systems News, 1(2):1-4, Mar. 1970.

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## APPENDIX I

## MANUFACTURERS OF SOLID WASTE PAPER SACKS*

1. Bancroft Bag, Inc.
   P.O. Box 307
   West Monroe, Louisiana 71291

2. Bemis Co., Inc.
   800-T Northstar Center
   Minneapolis, Minnesota

3. Crown-Zellerback Corp.
   One Bush Street
   San Francisco, California 94119

4. Gilman Paper Co.
   111 West 50th Street
   New York, New York 10020

5. Hudson Pulp and Paper Co.
   477 Madison Avenue
   New York, New York 10017

6. International Paper Co.
   Bagpak Division
   220 E. 42nd Street
   New York, New York 10017
   "Garbax Disposal System"

7. St. Regis Environmental
   Systems Division
   633 Third Avenue
   New York, New York 10017

8. Southern Bag Corp.
   P.O. Box 389
   Yazoo City, Mississippi

9. Union Camp Corp.
   1600 Valley Road
   Wayne, New Jersey 07470

10. U. S. Gypsum Co.
    Oakmont Packaging Division
    1155 Allegheny Avenue
    Oakmont, Pennsylvania 15139

11. West Virginia Pulp & Paper Corp.
    Bag Division, Papercan System
    P.O. Box 5207
    North Charleston, South Carolina
    29406
    "Westvaco"

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APPENDIX II

MANUFACTURERS OF PLASTIC SACKS AND LINERS*

1. American Can Co.
   Plastics Division
   100 Park Avenue
   New York, New York 10017

2. Bemis Co., Inc.
   800-T Northstar Center
   Minneapolis, Minnesota

3. Broyhill Industries
   Polymer Processing Division
   Lenore, North Carolina 28645

4. Cadillac Products, Inc.
   7004 E. 15 Mile Road
   Warren (Detroit), Michigan 48092

5. Central States Paper and Bag Co.
   5223 Natural Bridge
   St. Louis, Missouri 63115

6. Cherrin Products Co.
   6340 Miller Road
   Dearborn, Michigan 48126

7. Chicago Transparent Inc.
   2702 N. Paulina
   Chicago, Illinois

8. Davco, Inc.
   A Subsidiary of Chelsea
   Industries, Inc.
   Peabody, Massachusetts 01960

9. Dura-Lee Corp.
   1106 S. Mill
   Kansas City, Kansas 66105

10. Ethyl Corporation
    330 South Fourth Street
    Richmond, Virginia 23217 or
    100 Park Avenue
    New York, New York 10017

11. Extrudo Film Corp.
    111 West 50th Street
    New York, New York 10019

12. Fesco, Inc.
    P.O. Box 626
    Pittsburgh, Pennsylvania 15230

13. Great Plains Bag Co.
    2203 Bell Avenue
    Des Moines, Iowa

14. Gulf Plastic Products Co.
    Gulf Oil Corporation
    200 Maltese Drive
    Totowa, New Jersey 07512

15. Handi-Bag Corporation
    181 Spencer Avenue
    Chelsea, Massachusetts 02150

16. Home Plastics, Inc.
    5251 N. E. 17th Street
    Des Moines, Iowa 50313

17. Mellocraft Co.
    1320 Locust Street
    Toledo, Ohio 43601

18. Mobil Chemical Co.
    Plastics Division
    3848 Richard Street
    Macedon, New York 14502

19. Monsanto Co.
    Plastic Products and Resins
    Division
    200 North Seventh Street
    Kenilworth, New Jersey 07033

20. Packaging Products and Designs
    Corporation
    574 Ferry Street
    Newark, New Jersey 07105

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21. Pexco Packaging Corp.
201 Morris Street
Toledo, Ohio

22. Phillips Films Co., Inc.
A Subsidiary of Phillips Petroleum Co.
5570 Creek Road
Cincinnati, Ohio 45242

23. Quality Transparent Bag Co.
110 McGraw
Bay City, Michigan 48706

24. W. Ralston & Co., Ltd.
Rexdale, Canada

25. Rapco Plastics, Inc.
P.O. Box 659
612 E. McKinney
Denton, Texas 76201

26. Republic Molding Corp.
6330 W. Touhy Avenue
Chicago, Illinois 60648

27. Rexall Chemical Co.
P.O. Box 37
Wills Century Road
Paramus, New Jersey 07652

28. Rubbermaid Commercial Products, Inc.
Winchester, Virginia 22601

29. St. Regis Environmental Systems Division
633 Third Avenue
New York, New York 10017

30. Sinclair-Koppers Co.
Dept. TR69
Koppers Building
Pittsburgh, Pennsylvania 15219

31. Surrey Steel Components Ltd.
Surrey Sac
High Street
Barnes, London S.W.B.

32. Union Carbide Corp.
Chemicals and Plastics
270 Park Avenue
New York, New York 10017

33. USU Film Products
Division of U.S. Industrial Chemical Co.
41 Brooklyn Avenue
Brooklyn, New York 11216

34. Van Pak Products, Inc.
503 Williams Street
Tomah, Wisconsin 54660

35. Viking Poly Industries, Inc.
6325 Cambridge Exp.
Minneapolis, Minnesota 55416

36. Walton-March
1620 Old Deerfield Road
P.O. Box 340
Highland Park, Illinois 60035

37. Webster Industries Inc.
Environmental Control Products Division
A Subsidiary of Chelsea Industries, Inc.
58 Pulaski Street
Peabody, Massachusetts 01960

38. The Witt Co.
4454 Steel Place
Cincinnati, Ohio 45209

APPENDIX III

Communities Having Tested or Now Using Paper Sacks

Anchorage, Alaska
Scottsdale, Arizona
Camden, Arkansas
Pensacola Beach, Florida
Sarasota, Florida
Milledgeville, Georgia
Montezuma, Georgia
Smyrna, Georgia
Rolling Meadows, Illinois
Dubuque, Iowa
Junction City, Kansas
College Park, Maryland
Riverdale, Maryland
Hull, Massachusetts
Dearborn, Michigan
Lincoln Park, Michigan
Oak Park, Michigan
Riverview, Michigan
Southfield, Michigan
Southgate, Michigan
Tecumseh, Michigan
Trenton, Michigan
Belzoni, Mississippi
Picayune, Mississippi
Pontotoc, Mississippi
Poplarville, Mississippi
Raleigh, Mississippi
Collingswood, New Jersey
Montclair, New Jersey
Buffalo, New York
Elyria, Ohio
Mt. Wolf, Pennsylvania
Barrington, Rhode Island
Alvin, Texas
Farmers Branch, Texas
Fort Worth, Texas
Grandview, Texas
Portland, Texas
Wake Village, Texas
Weatherford, Texas
West Jordan, Utah
Amherst, Virginia
Fairfax, Virginia
Fredericksburg, Virginia

Communities Having Tested or Now Using Plastic Sacks

Vernon, Connecticut
Plantation, Florida
Tampa, Florida
Town of Guilford, Maine
Flint, Michigan
Marquette, Michigan
Florissant & St. Louis, Missouri
Kansas City, Missouri
Lakewood, New Jersey
Albuquerque, New Mexico
Albemarle, North Carolina
Arlington Heights, Ohio
City of St. Bernard, Ohio
Fairview Park, Ohio
Lebanon, Ohio
Monroe, Ohio
Rockey River, Ohio
Village of Indian Hill, Ohio
Village of Madeira, Ohio
Westerville, Ohio
West Lake, Ohio
Worthington, Ohio
Town of Newport, Tennessee
Bellaire, Texas
City of Lake Jackson, Texas

Communities Having Tested or Now Using Paper and Plastic Sacks

Little Rock, Arkansas
New York City, New York
Maumee, Ohio
Alexandria, Virginia